Health Burden of Pertussis in Adolescents and Adults

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Abstract: Pertussis in adolescents and adults is common, endemic, and epidemic worldwide, and its incidence is reportedly increasing. Although a number of individuals suffer only a mild cough, many others have symptoms typical of pertussis, causing prolonged cough illness, frequent use of health care resources, missed work and a variety of complications. Symptoms experienced by adolescents and adults include sleep disturbance, weight loss, pharyngeal discomfort, influenza-like symptoms, sneezing attacks, hoarseness, sinus pain, headaches and sweating attacks. Even when symptoms are typical of pertussis, the diagnosis is often not considered in adolescents and adults because of a low awareness of the disease in these age groups. Contrary to common perceptions, complications of pertussis, including some that are serious, are not infrequent in adolescents and adults. These include urinary incontinence, rib fracture, pneumothorax, inguinal hernia, aspiration, pneumonia, seizures and otitis media. Despite underreporting, hospitalization of adults and adolescents does occur. Many believe that adolescents and adults are the groups most commonly infected with pertussis and are now the major source of contagion to infants and young children. Because of the considerable health burden, there is a need for improved vaccination strategies to prevent disease in adolescents and adults and to reduce the risk of transmission to vulnerable infants.

Key Words: pertussis, health, burden, adults, adolescents

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Although pertussis traditionally has been considered a disease of childhood, it was well-documented in adults nearly a century ago[1] and is currently recognized as an important cause of respiratory disease in adolescents and adults, including the elderly.[2–6] Because of waning immunity, adult and adolescent pertussis can occur even when there is a history of full childhood immunization or natural disease.[7] Recognizing pertussis disease in adolescents and adults is important because these groups are conduits of infection to more vulnerable populations, including newborns and others in whom pertussis can cause severe and life-threatening illness.[7–13]

The Global Pertussis Initiative was created to fulfill a number of objectives. One of these objectives, a review of the literature assessing the health burden in adolescents and adults, is presented in this article. The process is explained in this supplement.[14]

INCIDENCE

The proportion of cases reported to the Centers for Disease Control and Prevention among persons ≥10 years of age has increased from 15.1% during the late 1970s, to 26.9% during the early 1990s[15] and to 49% in the early 2000s.[16] In 2000 in British Columbia, Canada, the incidence of pertussis among individuals ≥10 years of age surpassed that of all other age groups for the first time, with 45 and 27% of reported pertussis cases among individuals 10–19 and ≥20 years of age, respectively.[17] Some believe that this was related to a cohort effect from a poorly protective vaccine used earlier in Canada.

Studies from Canada, Denmark, Germany, France and the United States indicate that between 12 and 32% of adults and adolescents with a coughing illness for at least 1 week are infected with *Bordetella pertussis*.[2,18–26] In a comprehensive study in 1996–1997 that included 8 Canadian provinces, pertussis (defined by culture, polymerase chain reaction or serologic criteria) accounted for 33% of the prolonged cough illness in individuals 12–19 years of age, 19% in people 20–39 years of age, 19% in those 40–59 years of age and 16% in people ≥60 years of age.[25]

Seroepidemiologic studies have been performed in many countries, and widespread pertussis infection, primarily unrecognized, among adolescents and adults has been confirmed.[27–30] Rates of infection vary with the number of pertussis antibody responses measured and the case definitions of seropositivity. Serologic studies must be interpreted with caution, given that antibody responses to pertussis antigens other than pertussis toxin (PT) occur after infection with other *Bordetella* species and non-*Bordetella* infections, raising the possibility that isolated rises in these antigens may not be specific for *B. pertussis*.[31,32] In 1 study from the United States using a case

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definition of infection as a >50% rise in 2 of 3 pertussis antibodies [PT, filamentous hemagglutinin (FHA) or pertactin], 6.1% of 156 healthy adolescents had evidence of annual infections.[33] In other studies, peaks in antibody values to PT and FHA, unrelated to immunization or recognized infection (ie, asymptomatic infection), were observed in adolescents.[34,35] A seroepidemiologic study was performed in Spain to assess the prevalence of antibodies to PT and FHA in >4000 subjects ranging in age from 5 to 59 years.[28] Antibodies to PT and FHA were found in 35 and 65%, respectively, of children 5–12 years of age. In individuals 50–59 years of age, antibodies to PT and FHA were found in 52 and 80%, respectively. These results are consistent with a Japanese study that demonstrated elevated antibody titers in young adults.[30] Recurrent, unrecognized infection has also been suggested in another serologic study where health care workers were studied during a 5-year period. The yearly infection rate, as determined by rises in anti-PT antibodies, varied between 4 and 16%.[27]

Not surprisingly, and consistent with the observations noted above, pertussis does not spare the elderly. The attack rate in the elderly during a pertussis outbreak can be substantial and can increase with age. Among nursing home residents 55–74 and 75–94 years of age, clinical attack rates during a pertussis outbreak were 47 and 58%, respectively.[3] In a serologic surveillance study of 100 individuals 65 years of age or older during a 3-year period, 10% had serologic rises consistent with infection during the study period. Between one-third and one-half of the infections were symptomatic.[29] These and other data presented in the Epidemiology section of this supplement show that there is an increasing and important incidence of disease in adolescents and adults of all ages.

PERTUSSIS IN ADOLESCENTS AND ADULTS REMAINS UNDERRECOGNIZED AND UNDERDIAGNOSED

A prolonged, nondistinctive cough may be the only clinical feature of pertussis in adolescents and adults, who may or may not seek medical care. When they do seek care, their illness is often misdiagnosed, in part because clinicians continue to perceive pertussis as a childhood disease.[36,37] Failure to consider pertussis as a possible diagnosis also occurs even when symptoms are typical of classic pertussis.[38,39] When pertussis is considered as a diagnostic possibility, it is often not confirmed because routine laboratory tests are insensitive and tests that may be more sensitive are not standardized and may not be routinely available. The timing, specimen transportation and culture methods for *B. pertussis* all present problems that decrease the sensitivity of this diagnostic tool. Likewise, if acute phase serum is not collected early enough in the illness, titers often have already risen, making detection of a 4-fold rise between acute and convalescent sera unlikely. For this reason, some investigators have suggested that titer falls may be diagnostic for acute pertussis. Direct fluorescent antibody may be positive when cultures are negative because of antibiotic use, but this test is problematic in the hands of inexperienced technicians. In contrast, PCR techniques are capable of amplifying the material available in the sample and can increase the sensitivity of the diagnosis.[36,40–42] The comparative sensitivity and specificity of the various assays has been comprehensively reviewed by Hollander.[43]

CLINICAL MANIFESTATIONS OF PERTUSSIS IN ADOLESCENTS AND ADULTS

Adolescents and adults who have mild symptoms or who are asymptomatic rarely are diagnosed with pertussis. Although clinical manifestations of pertussis in adolescents and adults may be atypical and limited to a mild cough,[11,38,44] many will suffer severe symptoms.[23] In a German study comparing adults (18–73 years of age) with children, the dominant symptom in adults was a persistent cough, although less characteristic than the classic paroxysmal cough in children.[45] In contrast, other studies suggest that between 21 and 86% of adults have classic pertussis symptoms such as paroxysmal cough, whoop and posttussive vomiting.[6,26,46–48] Some authors have suggested that 80% of adults with pertussis have cough that persists for >21 days,[49] and others have shown that 27% of adults are still coughing 90 days after disease onset.[47] In studies from France and Australia, the

TABLE 1. Frequency of Clinical Symptoms of Pertussis in Adolescents and Adults[6,24,26,38,47–49,53]

Clinical Characteristic	At Diagnosis (%)		During Disease (%)	
	Adolescents (10–19 yr)	Adults (≥20 yr)	Adolescents (10–19 yr)	Adults (≥20 yr)
Paroxysms	83	87	82–83	33–100
Whoop	30	35	30–47	7–82
Apnea	19	37	19–32	29–37
Cyanosis	6	9	6–15	9–12
Vomiting	45	41	45–53	17–62
Hospitalization	1.4	3.5	1.4–7.5	3.5–5.7
Cough >4 wk			41	52

median duration of pertussis among adults was 7–8 weeks (range, 2–26 weeks).[19,47] Other symptoms observed during illness in adults include sleep disturbance (52–84%), pharyngeal symptoms (37%), weight loss (33%), influenza-like symptoms (30%), sneezing attacks (22%), hoarseness (18%), sinus pain (16%), sweating attacks (14%) and headaches (14%).[47,49] Although some studies have reported a different spectrum of symptoms during illness among different age groups, there seems to be as much variation in reported symptoms within age groups as between age groups. The frequency of different clinical symptoms at the time of diagnosis and during illness are listed in Table 1.

PERTUSSIS-RELATED COMPLICATIONS IN ADOLESCENTS AND ADULTS

Contrary to common perceptions, complications of pertussis, including serious ones, are not uncommon in adolescents and adults, especially the elderly. Although the lack of population-based data makes it impossible to measure the level of risk in various adult age groups, case reports describe a variety of problems. In one study, 23% of patients 19–83 years of age had complications.[49] Urinary incontinence has been reported in 4% of adults in general and in 34% of women >50 years of age.[49] Pneumothorax, inguinal hernia, aspiration, hearing loss, fractured ribs and carotid artery dissection have all been reported.[47–49,50] Severe paroxysmal cough might be expected to increase the risk of fractures (especially of the ribs) in patients with osteoporosis and the risk of intracranial bleeding in elderly patients (especially those on anticoagulants). Seizures and encephalopathy also occur, but in fewer than 1% of patients.[47,51–55] Complications have been reported to be more frequent in adults than in adolescents (28% versus 16%).[53] Pneumonia has been reported in 2–4% of individuals 10–19 years of age, 2.7–5.5% of those >20 years of age and 5–9% of those >30 years of age.[51–53] The proportions of individuals with symptomatic infections may be overestimated, given that only the most symptomatic patients seek medical care.

HOSPITALIZATION

Despite underreporting, pertussis-related hospitalization of adolescents and adults does occur.[6,51,52] Of those cases reported, 1.4–7.5% of individuals 10–19 years of age and 3.5–5.7% of individuals ≥20 years of age required hospitalization.[6,51,52] In one study, the mean duration of hospitalization for all ages was 7 days.[51] In addition, there is evidence that longer periods of hospitalization are seen in older individuals, with average lengths of stays of 6.3 and 8.7 days for those 10–50 years of age and >50 years of age, respectively.[56]

MORTALITY

In general, death from pertussis is rare beyond the age of 10 years, occurring in ~0.1% of cases.[51,52] Older adults appear to be at greater risk than younger adults of pertussis-related mortality. Of patients 55–94 years of age who died with pertussis, intracranial hemorrhage was often implicated.[3] In a study of hospitalized patients with pertussis in Spain during the 4-year period 1995 to 1998, the case-fatality ratio was higher in hospitalized persons with pertussis >50 years of age (29%) compared with those who were 1–5 years of age (1%).[56]

CONCLUSIONS

Despite common misconceptions that pertussis either does not occur in adolescents and adults or is only a mild illness, it remains an important cause of respiratory disease in these age groups. Although it is true that pertussis disease may present with only chronic and nondistinctive cough, many individuals will have more classic and severe symptoms that can cause prolonged illness and frequent use of health care resources. Case reports describe a variety of complications, some of which are serious. In addition to the underappreciated morbidity in adolescents and adults, recognizing pertussis disease in these older age groups is important because they are conduits of infection to more vulnerable populations, including newborns, young infants and others in whom pertussis may be a serious or life-threatening illness. It is clear, therefore, that pertussis disease occurring beyond childhood represents a considerable health problem. Immunizing adolescents and adults could help reinforce the protection afforded by childhood and infant vaccination programs.

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